

Utilization of MCR Ocean Dredged Material Disposal Sites During 1999 and Recommendations for 2000

Purpose and Summary

Approximately 4.4 million cy/yr of sand is dredged at the Mouth of the Columbia River (MCR) entrance channel, based on 10 year average from 1988-1998. The dredged material (sand) is placed at designated ocean dredged material disposal sites (ODMDS) or at sites permitted through Section 404 of the Clean Water Act (404 site). Figure 1 shows regional bathymetry of MCR and dredged material disposal sites.

During the 1999 dredging season (June-October), 5.06 million cy of sand was dredged from the MCR navigation channel and placed in three disposal sites: The North Jetty site, ODMDS E , and ODMDS F. Approximately 3.75 million cy of dredged sand was placed at ODMDS E, 1.05 million cy was placed at the North Jetty site, and 261,000 cy was placed at ODMDS F. The North Jetty site (a 404 site) was first used in 1999 and is located along the southern side of the MCR north jetty, in water depths of 40–70 ft. ODMDS E is located 1/4 mile seaward of the MCR north jetty, in water depth of 50-65 ft, and is considered to be within the active littoral zone of MCR. ODMDS F is located about 4 miles offshore from the north jetty in water depth of 100-170 ft and is considered to be seaward of the active littoral zone at MCR.

As part of the management plan for an ODMDS used for dredged material disposal, the bathymetry of the site is monitored to determine the extent of dredged material accumulation on the seabed. This report specifically describes observed bathymetric change at MCR dredged material disposal sites during 1999, based on the comparison of several hydrographic surveys. This report also presents recommendations for utilization of ODMDS E and the North Jetty site during 2000. Page 8 of this report summarizes bathymetric surveys and related computations made for ODMDS E during 1999. Supporting information and details are presented on page 8-9.

To avert excessive mounding of placed dredged material within ODMDS E during 1999, an attempt was made to distribute dredged material uniformly throughout the site using a series of pre-assigned grid-cells to control the release point for each disposal event [USACE 1999a]. A similar approach was also used for placement of dredged material at the North Jetty site. The objective was to prevent mound-induced wave amplification at or near ODMDS E by limiting the vertical accumulation of placed dredged material to 4-6 ft , with respect to the May 1997 (*baseline*) bathymetry of ODMDS E [USACE 1998b]. The baseline bathymetry for ODMDS E is shown in figure 2. Figure 3 shows the distribution of grid-cells used to guide the placement of dredged material within ODMDS E and the North Jetty site during 1999.

Bathymetry Change at ODMDS E during 1999

Figure 4 shows the bathymetry at ODMDS E as of 23 May 1999, prior to 1999 dredged material disposal. This survey documents the pre-disposal condition of ODMDS E for 1999. Figure 5 describes the difference between the baseline condition survey (May 1997) and the pre-disposal survey for 1999. Note the erosion (more than 5 ft) that occurred through the eastern half of ODMDS E. In the western half of ODMDS E, there was still some dredged material remaining from the 1998 disposal season. For this reason, it was anticipated at the beginning of the 1999 dredging season that the eastern half of ODMDS E was to be used more than the western half of the site for dredged material disposal during 1999.

During 4 June – 26 August 1999, a contractor-operated hopper dredge placed 1.4 million cy of dredged material in the western half and 1.0 million cy in the eastern half of ODMDS E. Figures 6 and 7 show the distribution and accumulation of dredged material placed by the contractor dredge within ODMDS E. After 13 July, no dredged material was placed within the western half of ODMDS E. During 14 July -26 August, the contractor dredge used the eastern half of ODMDS E for dredged material placement. During 12 September – 15 October 1999, a government-operated hopper dredge placed 1.35 million cy of dredged material within the eastern half of ODMDS E. Figure 8 documents the bottom accumulation of dredged material that occurred within ODMDS E during 23 May 1999 - 20 October 1999. The total volume of dredged material (sand) placed within ODMDS E during 1 June – 15 October 1999, was 3.75 million cubic yards (cy). Approximately 1.4 million cy was placed in the western half and 2.35 was placed in the eastern half of ODMDS E. As of 20 October, monitoring results indicate that 61% (or 2.3 million cy) of all dredged material placed at ODMDS E during 1999 was observed to have accumulated on the seabed of the site. In other words, during the 1999 dredging-disposal season, the wave/current environment at ODMDS E had dispersed 39% of all dredged material placed at this site.

The accumulation of dredged material within ODMDS E (shown in figure 8) is due to more material being placed in the eastern half of the site than the western half. The apparent over utilization of the *eastern* half of ODMDS E occurred due to two (2) considerations:

- 1) At the beginning of the 1999 dredging-disposal season, it was noted that the western half of ODMDS E had some dredged material remaining from the 1998 disposal season (figure 5). It was also observed that the eastern half of ODMDS E was deeper than the baseline condition (1997), due to seabed erosion. To avoid overloading the western half of the site and to take advantage of enhanced dispersion (erosion) within the eastern half of the site, the eastern half of ODMDS E was used more heavily than the western half of the site.
- 2) The management plan for ODMDS E stipulates that the western half of the site is not be used for dredged material disposal after 15 August. During 1999, MCR dredging

(and use of ODMDS E) occurred until 15 October. This meant that for the last 2 months of MCR dredging during 1999, only the eastern half of ODMDS E was available for dredged material disposal. Although ODMDS F was available, use of ODMDS E was favored due to the site's short haul distance and the desirability to place dredged material within the littoral environment.

Based on the results of a 16 September 1999 survey of ODMDS E, Portland District determined (in late September) that utilization of ODMDS E (the eastern half) should be restricted, for the remainder of the 1999 dredging-disposal season. Beginning in October 1999, dredged material was placed at ODMDS F instead of E. Keep in mind that the total estimated capacity remaining within ODMDS F is now less than 9 million cy [USACE 1997].

Figure 9 shows the degree of seabed change observed on Peacock Spit between 23 June to 15 September 1999. During summer 1999, it appears that dredged material placed at ODMDS E was transported in two primary directions; depending on where the dredged material was placed within ODMDS E. Dredged material placed within the *eastern half* of the site appears to be transported toward the north-northwest. Dredged material placed within the *western half* of the site appears to be transported toward the west-northwest. Based on results shown in figure 9, dredged material placed at ODMDS E during 1999 does not appear to be moving south toward the navigation channel.

Bathymetry Change at the North Jetty Site during 1999

Figure 5 shows the degree of seabed lowering (erosion) that has occurred between 1997-1999 along the seaward end of the north jetty. The same process has also been occurring along the south side of the north jetty, along the structure's toe. Placement of up to 1 million cy of dredged material per year at the North Jetty (NJ) site is intended to replace sediment that has eroded from the southern toe of the north jetty, thereby protecting the structure from deterioration (caused by toe scour and related slope instability).

Between 15 June and 12 September 1999, the government hopper dredge placed 1.05 million cy of dredged sand within the NJ site. Figure 10 is a difference plot between the 15 June and 20 October surveys of the NJ site. Bathymetry contours shown in figure 10 indicate the seabed elevation within the NJ site as of 15 June 1999, before placement of dredged material at the NJ site. Note the scour area paralleling the north jetty. The object of placing dredging material within the NJ site during 1999 was to fill the scour area. Although dredged material was placed 300 ft south of the jetty (offset for reasons navigation safety and jetty slope stability), most of the dredged sand placed in the NJ site did act to accomplish the objective of protecting the toe of the north jetty from scour. The maximum height of dredged material accumulation with the NJ site was 7 ft (figure 10). As of 20 October 1999, approximately 76% of all material placed within the NJ site was present.

Bathymetry Change at ODMDS E between 1997 and 1999

In 1997, ODMDS E was expanded to allow increased use of the site (for dredged material disposal). Based on recommendations made in USACE [1998a], the bathymetric survey obtained during 9 May 1997 (figure 2) defines the project “baseline” condition for ODMDS E. The site’s “baseline” survey documents the condition of ODMDS E immediately after expansion of the site, prior to the placement of dredged material in 1997. Subsequent ODMDS E surveys are compared to the “baseline” condition to monitor accumulation of dredged material placed within the site. ODMDS E is managed by the Corps to prevent wave amplification, due to excessive mounding of placed dredged material.

Between May 1997 and October 1999, approximately 8.3 million cy of dredged sand has been placed at ODMDS E (3.75 mcy in 1999, 3.45 mcy in 1998, and 1.1 mcy in 1997). Figure 11 shows the difference between the ODMDS E baseline survey (May 1997) and the 20 October 1999 survey. Based on the difference between the site’s baseline survey and the 1999 post-disposal survey (20 October 1999), approximately 90% of the bathymetry at ODMDS E had experienced net deposition (presumably due to dredged material accumulation) during 1997-1999. However, the area between the MCR north jetty and the eastern end of ODMDS E has experienced continual erosion since 1997. Significant erosion also occurs within the eastern half of ODMDS E during winter-spring (between dredging seasons, see figure 5). Monitoring results indicate that only 20% (or 1.47 million cy) of all dredged material placed at ODMDS E during 1997-1999 is still present on the seabed of the site. This means that during 1997-1999, the wave/current environment at ODMDS E has dispersed 80% of all dredged material placed at this site. Based on results shown in figure 11, less than 300,000 cy (4%) of the dredged material placed at ODMDS E since 1997 is migrating south toward the navigation channel.

As of 20 October 1999, the maximum observed height of dredged material accumulation at ODMDS E, with respect to the site’s baseline bathymetry (9 May 1997), was 6 ft. The target values for vertical accumulation of dredged material (with respect to the baseline condition of 1997) were based water depth dependent thresholds shown in table 1 [USACE 1998 and USACE 1998b].

TABLE 1. Limiting dredged material mound height based on water depth.

Seabed Elevation	Limiting (mound) Height for Dredged Material Accumulation
-50 ft MLLW	4 ft
-60 ft MLLW	5 ft
-65 ft MLLW	6 ft

Based on the average water depth of ODMDS E (55 ft for the baseline condition), an average accumulation threshold of 4.5 ft was adopted for management purposes. As of 20 October 1999, about 10% of the bathymetry at ODMDS E had accumulated sediment greater than 4.5 ft high, with respect to the baseline condition. Based on recent wave

analysis results [USACE 1999b] , there is a potential for wave amplification in vicinity of ODMDS E due to the change in bottom elevation (accumulation of dredged material within ODMDS E boundaries) between 1997 and 1999. The potential wave amplification is attributed to exceedance of the 4.5 ft accumulation threshold at ODMDS E. No wave amplification was predicted to occur within the MCR entrance channel.

Since 20 October, there have been several storm events that produced waves that exceeding 20 ft (high). Based on previous monitoring results documenting the response of dredged material placed at ODMDS E to the environmental forcing [USACE 1999a and USACE 1998ab], it is estimated that the "high points" of dredged material accumulation at ODMDS E (as of 20 October 1999) have been reduced by 2-3 ft vertically (between the time period of 20 Oct - 7 Dec). Reducing the dredged material accumulation within ODMDS E by 2-3 ft is believed to eliminate any potential wave amplification effect associated with the 20 October condition.

Figure 12 shows the bathymetry change at ODMDS E (during 1997-1999) in context of the large scale seabed changes occurring at MCR. Overall, the regional bathymetry of MCR is fairly active. Note that bathymetry changes occurring at ODMDS A (6 ft of erosion) and B (erosion and deposition) due to natural processes. Deposition in the northern half of ODMDS F is the result of dredged material disposal during 1998 (the 1999 survey was taken before dredged material was placed with ODMDS F during 1999). Note that the crest of Peacock Spit (northwest of ODMDS E) has experienced 2 ft of erosion during 1997-1999 while the base of the spit has experienced deposition. Figure 12 indicates that during 1997-99, some of the dredged material placed at ODMDS E has been transported southward into the navigation channel. Along the outer end of the south jetty, there appears to be 2-6 ft of erosion.

Longterm Bathymetric Change at ODMDS E and Peacock Spit

An attempt was made to estimate the long term fate of dredged material placed at ODMDS E by comparing the present bathymetry of Peacock spit with that of 1958 (figure 13). This would integrate the effects of seabed change on Peacock Spit, due to natural forces and placement of dredged material at ODMDS E. Note that since 1973, approximately 56 million cy of dredged sand has been placed at ODMDS E (as compared to 8 million since 1997).

Figure 13 is a difference between surveys acquired in September 1999 and July 1958 and shows the degree of seabed change that has occurred on Peacock Spit during the 39 year period. Note that much of Peacock Spit, between 50-60 ft depth, has eroded during this time while areas deeper than 70 ft have experienced pronounced deposition. Essentially, the top of Peacock Spit is being sheared-off (by waves and currents) and the sediment is being deposited at the west and northwest base of the spit. Also note the significant erosion immediately south of ODMDS E, along the MCR entrance channel. This is believed to be due to:

A) MCR dredging and related channel sideslope adjustment. This is a localized process.

B) Natural channel migration, toward the north. This is a regional process.

It appears that as the “natural” MCR channel migrates northward, Clatsop Spit is following suite: Migrating north into the “project” limits of the MCR navigation channel.

Between 1958 and 1999, it appears that dredged material placed at ODMDS E has been transported primarily north-northwest (and then east-southeast) as indicated by the pink vectors in figure 13. It is speculated that if dredged material had not been placed at ODMDS E (1973-1999), erosion would have occurred over a much larger area of Peacock Spit than what is indicated at present. Consequently, Benson Beach (Ft. Canby State Park) would have experienced significantly higher erosion (landward recession). Based on results shown in figure 13, dredged material placed at ODMDS E during does not appear to be moving south toward the navigation channel (at least in any appreciable quantity).

Summary and Recommendations

Between 23 May -20 October 1999, 3.75 million cy of dredged material was placed in ODMDS E resulting in approximately 2.3 million cy of the placed dredged material accumulating on the seabed within the site boundaries. As of 20 October 1999, dredged material accumulation has exceeded the management target threshold (4.5 vertical ft) for about 10% of the bathymetry at ODMDS E. This exceedance was limited to the eastern half of the site and had the potential to amplify incident waves, by 10-30% as compared to the 1997 “baseline” condition. Based on recent storm (wave) events, it is estimated that the “high points” of the dredged material accumulation at ODMDS E have been reduced by 2-3 ft vertically (between the time period of 20 Oct - 7 Dec 1999). Erosion of the dredged material accumulation within ODMDS E by 2-3 ft is believed to eliminate any wave amplification effect associated with the 20 October 1999 condition.

The magnitude and direction at which dredged material (placed within ODMDS E) is transported out of ODMDS E appears to be a function of *where* the dredged material is placed within the site. Dredged material placed within the eastern half of ODMDS E is believed to be transported north-northwestward onto ridge of Peacock Spit, and ultimately toward Benson beach. Dredged material placed within the western half of ODMDS E is believed to be transported west-northwestward onto ocean-facing slope of Peacock Spit. Dredged material that is transported onto the ocean-facing slope of Peacock spit appears to be carried along the flank of the spit (parallel to the bathymetry contours) in a contour-clockwise path, and ultimately carried back toward shore. Dredged material placed in the eastern half of ODMDS E appears to be subjected to a *higher* transport potential than dredged material placed in the western half of the site.

As of 20 October 1999, the total remaining capacity of ODMDS E (western half) was estimated to be 400,000 cy. Assuming that no additional sediment has accumulated within or eroded from the site since October 1999, the minimum capacity of the site available for 2000 dredging disposal is estimated to be 400,000 cy. This is the most

conservative (low) estimate that can be made for the available disposal capacity at ODMDS E in 2000, but does not reflect past experience.

Based on ODMSD E monitoring for 1997-1998, it is expected that most dredged material residing within ODMDS E as of 20 October 1999 will be dispersed out of the site by June 2000. Actual capacity of ODMDS E available for 2000 (for dredged material disposal) will be determined based on the 2000 pre-disposal survey.

Recommendations: For advance planning purposes, it is recommended that ODMDS E be considered for no more than 2 million cy of dredged material disposal during 2000. This recommendation will be verified, before commencement of the 2000 dredging-disposal season, when ODMDS E is surveyed in May or June 2000.

A pre-disposal survey of the North Jetty site should be obtained in spring 2000 (similar to coverage as the site's 20 October 1999 survey) to determine how much of the material placed at the NJ site in 1999 remains in 2000. An assessment will be made to determine the volume of dredged material that can be placed in the NJ site for 2000. For advance planning purposes, it is recommended that the NJ site be considered for no more than 500,000 cy of dredged material disposal.

It is recommended that the areal coverage of the 2000 pre-disposal survey should, at a minimum, be similar to the extent shown in the top graphic of figure 14.

To minimize future potential wave amplification effects at ODMDS E, greater effort must be made to avoid (localized) exceedence of mounding height criteria. The mounding criterion of 4.5 ft (with respect to the site's 1997 "baseline" condition) should not be exceeded. It is suggested that ODMDS E not be used aggressively without applying strict "uniform spreading" protocol throughout the entire dredging season.

Any dredged material that cannot be placed in either the North Jetty site or ODMDS E will be placed within ODMDS F. Should dredged material be placed within ODMDS F, it should be spread *uniformly within the northern half of the site.*

***Utilization of MCR Ocean Dredged Material Disposal Sites
During 1999
Supporting Information***

Summary Information

Overall period of monitoring for 1999 = 23 May – 20 October 1999
Open water disposal site = North Jetty Site and ODMDS E & F
Dredging Vessels used = multiple bottom-door hopper dredge *Essayons* and
split-hull dredge *Padre Island*
Sediment dredged = fine-medium sand (average grain-size = 0.22 mm)

Surveys conducted in 1999: 23 May 1999 (Site E, 200 ft spacing) , 15 June 1999 (Peacock Spit - 2x2 miles, 750 ft Spacing and North Jetty site 200 ft spacing), 23 June 1999 (Site E, 200 ft spacing), 14 & 21 July 1999 (Site E, 200 ft spacing), 2 August 1999 (Site E and North Jetty site, 200 ft spacing), 21 Aug 1998 (Site E, 200 ft spacing), 16 Sept 1999 (Site E, 200 ft spacing and Peacock Spit - 2x2 miles, 750 ft spacing), 20 Oct 1999 (Site E & North Jetty Site, 200 ft spacing), 23 Aug 1999 (Site F, 400 ft spacing)
“Monitoring Baseline condition” for ODMDS E is documented by the survey of May 1997
“Monitoring Baseline condition” for Peacock Spit is documented by the 2x2 mile survey of 9 July 1998

Volume of Dredged Material Placed at ODMDS E

Volume of dredged material placed in **western half** of ODMDS E, by *Padre Island*, during
4 June – 13 July = 1.4 million cy (563 dumps)

Volume of dredged material placed in **eastern half** of ODMDS E, by *Padre Island*, during
13 July – 26 August = 1.0 million cy (422 dumps)

Volume of dredged material placed in **eastern half** of ODMDS E, by *Essayons*, during
12 Sept – 15 Oct = 1.35 million cy

Total volume of dredged material placed within **entire** ODMDS E during
1 June – 15 Oct = 3.75 million cy

Volume of Dredged Material Placed at North Jetty Site , by *Essayons*, during
15 June – 12 Sept = 1.05 million cy

NOTE: MCR Dredged material placed at **ODMDS F** during 1999 = 262,000 cy (by *Essayons*)

Volume of Material Observed to be on Seabed at ODMDS E

Accumulation on seabed within ODMDS E for:

23 May – 2 August 1999 = 1.3 million cy (2.0 million cy actually placed)

Maximum height of dredged material accumulation = 6 ft, 65% of all material placed retained on seabed

Accumulation on seabed within ODMDS E for:

23 May – 20 September 1999 = 2.3 cy (3.75 million cy actually placed)

Maximum height of dredged material accumulation = 7 ft, 61% of all material placed retained on seabed

Accumulation on seabed within ODMDS E for:

9 May 1997 – 20 October 1999 = 1.7 million cy (8.1 million cy actually placed)

20% of all material placed retained on seabed..... or 80% dispersed

Volume of Material Observed to be on Seabed at North Jetty Site

Accumulation on seabed within North Jetty Site for:

15 June – 20 October 1999 = 0.8 million cy (1.05 million cy actually placed)

76% of all material placed retained on seabed or 24% dispersed

References:

USACE (1999a). "Utilization of MCR Ocean Dredged Material Disposal Sites During 1998 and Recommendations for 1999". Portland District – US Army Corps of Engineers.

USACE (1999b). "Analysis of Ocean Wave Conditions at MCR Associated with Seabed Elevation Changes between 1997 and 1999". Portland District – US Army Corps of Engineers.

USACE (1998a). "Analysis of MCR ODMDS Utilization for 1997 and Proposed Options for ODMDS Use in 1998 - for ODMDSs A, B, E and F. With Addendum". Portland District – US Army Corps of Engineers.

USACE (1998b). "Observed Bathymetric Change at MCR ODMDS E during 1997-98 and Available Disposal Capacity for 1998". Portland District – US Army Corps of Engineers.